

Reducing the potential for bidder regret also reduces the "winner's curse." This reduction in the "winner's curse" tends to increase (on average) prices paid for the licenses and permits the market to determine which aggregations of licenses make good business sense. Reducing the scope for bidder regret also minimizes the likelihood that bidders will wish to withdraw winning bids.

The ability to withdraw insures the bidders against winning too much, permitting them to follow aggressive strategies. Finally, even when bidders do withdraw winning bids, the government is effectively insured against losses because what the government loses in revenue from awarding the license to the second-highest bid, it approximately gains in the forfeited payment. See PacTel Auction Design Comments at footnote 19.

#### **D. Rules for Ending the Auctions**

The experts retained by Pacific Bell, Professors Milgrom and Wilson, propose to auction licenses simultaneously and keep all the auctions open until there is no new bidding on any license. In addition, they proposed that bidders who wish to withdraw from any single winning bid are eliminated from obtaining any licenses at all. Effectively, any bidder desiring to withdraw on one license is forced to withdraw from participation in the auction, forfeiting the up-front payment on all licenses.

While I am sympathetic with the attempt to leave all the auctions open, such Draconian penalties for withdrawal create difficulties for the auction to actually incorporate the values of the bidders. The ability of a dormant license to suddenly erupt into bidding further exacerbates the problem. Under both my proposal and that of Professor's Milgrom and Wilson, bidders must bid more than their valuation of the licenses as independent licenses in order to acquire more valuable aggregations of licenses. Under the Milgrom-Wilson proposal, if a bidder fails to acquire the aggregation of its choice, perhaps because one of the licenses has become unexpectedly expensive, it

is faced with the choice of either exiting the auction and forfeiting all of its up-front payments, or purchasing remaining licenses at a loss. In contrast, the auction design recommended here would allow bidders to exit particular auctions, forfeiting only the up-front payment for those particular auctions. The advantage of this is that bidders can take a risk attempting to assemble an aggregation of licenses, knowing that if it fails to achieve the aggregation, it can withdraw from the other acquired licenses at a relatively small cost, i.e., the up-front payment on those particular licenses.

The basic economic point is that it is desirable to encourage bidders to take some risks attempting to put together aggregations of licenses, i.e., to bid more than these licenses are worth alone. Professors Milgrom and Wilson would penalize this behavior heavily. In contrast, the auction design recommended here encourages this behavior.

To understand the problem, consider a bidder who currently has the high bids, at \$15 each, on two licenses, A and B. Assume these are worth \$20 each by themselves, and \$50 together. Given that the bidder wins license A, license B is worth \$30 to this bidder, and the bidder could be forced by competition to pay, say, \$29 for license B. If at this point the auction for license A suddenly becomes active, similar reasoning says that the bidder would also pay \$29 to keep A.<sup>5</sup> Thus, the bidder might, by the sequencing of auctions, be forced into paying \$58 for a pair of licenses worth \$50. No rational bidder will let this happen with high probability, but the way a rational bidder avoids this problem is to drop out of the bidding well before the prices reach the full value of the license, for fear of the holdup possible if some currently inactive licenses suddenly become active.

In contrast, the auction design recommended here allows the bidder to withdraw from the license at a cost equal to the up-front payment for that license. This lowers the

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<sup>5</sup> This assumes that the bidder holds B at \$29. Under the proposal of Professors Milgrom and Wilson, it is very difficult for the bidder to back out of this state of affairs.

risk of aggressive bidding without cost to the government, which collects the up-front payment and sells the license for slightly less. In addition, the recommended auction design (see PacTel Auction Design Comments at 16-17 and 31-32) stops inactive auctions permanently, therefore letting a bidder lock in a piece of an aggregation, which protects that bidder from further price increases in that license. Thus, under my proposal, the unexpected restarting of bidding on license A is not possible. The proposed stopping rule described in my previous report (see PacTel Auction Design Comments at 16-17 and 31-32) permits bidders to express the combination value of a group of licenses in the individual bids, without substantial risk of being forced to pay too much.

Of course, to exploit the full value of simultaneous auctions, it is important to have all the auctions open at the time when they approximately reach their final prices. The auction design recommended here accomplishes this by slowing down the rate of increase in prices as the auctions near termination, by making the bid increments smaller when there are fewer bidders. Thus, auctions that will eventually produce higher prices run at a relatively rapid pace, while auctions that are about to close, because competition has been narrowed to two or three interested bidders, slow down. This ensures that, as the prices converge to their final levels, a point is reached when prices are close to their final prices, but most or all of the auctions remain open.

### **III. Oral versus Repeated Sealed-Bid Auctions**

The benefits attributed by many respondents, including AT&T, Cellular Telecommunications Industry Association ("CTIA"), and others, to *oral* auctions actually apply to any ascending-bid auction. These advantages include revision of bids in light of bidding behavior by others, and the perception of openness. The ascending bid auction advocated here possesses all of the advantages of the oral version of the auction, but

permits simultaneity of the auctions, time to consult between bids, and concealment of the identity of the bidders, in contrast to oral auctions.

As oral auctions are necessarily sequential, they create all the difficulties associated with sequential auctions. Several respondents request that the bidders' identities be kept secret, and although this is clearly a good idea, it is not enough. Oral auctions will still tend to release information about the identities of the bidders, even when the Commission takes steps to conceal their identities. In addition, "deep-pocket" bidders may want to reveal their participation, hoping to deter others from participating, on the principle that winning against certain bidders (e.g., better informed and wealthier bidders) typically means paying too much.

Consider, for example, the position of a bidder who knows that a well-informed, deep-pocket bidder has a high willingness to pay for a particular license, but that the exact value of the license is not known by any bidder. In deciding whether to bid against such a deep-pocket bidder, the first bidder understands that if she were to win an auction in which the well-informed, deep-pocket bidder participated, her winning bid would likely exceed the value of the license. Understanding this, the first bidder may choose not to compete in auctions against such well-informed, deep-pocket bidders. The known participation of deep-pocket bidders, thus, tends to reduce competition in the auction, reducing prices actually paid. Therefore, the Commission should insist that the identities of the bidders be kept secret, to promote more effective competition.

Finally, several firms, including Pacific Bell, do not consider collusion a problem with oral bidding. While I agree that explicit collusion is very unlikely, it is nonetheless possible that revealing the identities of the bidders will facilitate implicit collusion.

#### **IV. Disadvantages of a Separate National License**

Many of the comments reflect a preference against the Commission's proposal for a national license auction on the 30 MHz licenses. In particular, American Personal Communications, Cellular Communications, Pacific Bell, BellSouth, McCaw, Paging Network, GTE, Sprint, Southwestern Bell, Comcast, Telelocator, AT&T, and several representatives of small firms oppose combination bidding for a national license. This is not surprising. A national license favors a few bidders at the expense of others and at the expense of the national interest, for it creates a distinct likelihood of a national license selling even when the MTAs are worth more individually than as a national license. Professor Weber, representing TDS, is particularly eloquent on this point.

Proponents of a national license, e.g., CTIA, MCI, and Bell Atlantic, do not offer powerful arguments in favor of such a separate auction. CTIA's own expert, Professor Mark Isaac, argues for the utility of full combinatorial bidding in his report. That is, his argument does not favor a national license, but rather favors full combinatorial bidding. It is illogical to conclude from this argument that a national license is desirable in the absence of other combinations being offered.

CTIA's argument that the bid price for the national license creates an "implicit reserve price" is false. While it may be true that if each firm bids at least the pro-rated value of the bid on the national license,<sup>6</sup> then licenses will be sold individually, there is nothing in CTIA's proposal to induce bidders to bid that high. Indeed, one expects that the per person value of PCS licenses varies from area to area, with urban areas likely producing higher per person values. Therefore, bidders should not expect that licenses from low density areas will sell for prices proportional to high density areas. As a

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<sup>6</sup> The pro-rated value for an MTA is calculated by taking that national bid, dividing by the total population to find the price per person, and multiplying that figure by the number of people in the MTA.

consequence, the implicit reserve price of CTIA's proposal is unlikely to become even a focal point in the bidding, much less an inducement for a firm to raise its bid to prevent the license from selling nationally, when it can reasonably hope to "free ride" on later bidders.

MCI's proposal, which advocates a second-price or Vickrey auction on the national license, actually *exacerbates* the free-rider problem relative to the Commission's proposal. Since oral auctions tend to produce the second highest expected valuation as an equilibrium price, and Vickrey auctions tend to produce the highest expected valuation as a winning bid, the MCI proposal is tantamount to comparing the *highest* expected valuation on the national auction to the *second-highest* expected valuation on the individual licenses, insuring that a national license not only sells in circumstances where it is valued significantly less than the licenses are valued individually, but sells at a lower price as well.

MCI's proposal does not support the national interest in either efficiency or raising revenue, but effectively offers a subsidy for a national license even greater than the subsidy inherent in the Commission's proposal. MCI's proposal does not merit serious consideration, for it amounts to a proposal to subsidize a nationwide bidder at the taxpayers' and PCS consumers' expense. The likely outcome, were MCI's proposal adopted, is a very high bid for a national license, but a very low price actually paid.

Bell Atlantic's experts, Professors Bulow and Nalebuff, discuss a national license in Appendix B of their report, pp. 25-31. In their discussion they make two errors. First, they *assume* that a national license is the only aggregation that has any value. This is certainly not in accord with the facts. It is clear that aggregations of cellular licenses beyond the MTA level have been profitable and served consumers well. It is not at all clear that a national license is even efficient, much less the only efficient aggregation. Second, even if a national license were the only important aggregation, their proposal promotes inefficient aggregation, which they ignore. Indeed, they describe an example in

which it is assumed that bidders both know and choose to bid their value for the license. As is well established in the auction literature, bidders in an auction will act strategically to maximize profits, which involves bidding less than their maximum willingness to pay, contrary to the discussion in the report of Professors Bulow and Nalebuff.

## V. Full Combinatorial versus Simultaneous Auctions

A significant number of the respondents indicate a preference for either simultaneous auctions or full combinatorial auctions. In particular, NYNEX, National Telecommunications and Information Administration ("NTIA"), Pacific Bell, Ameritech, and CTIA all advocate auctions that permit the bidders to express the interdependencies of the values of the licenses, either by simultaneous auctions, or by use of combinatorial auctions, where users can define subsets of the licenses on which to bid.

Full combinatorial auctions were recommended by several respondents, including CTIA,<sup>7</sup> Ameritech, NYNEX, and NTIA. Combinatorial auctions have two fatal defects. First, as the Commission noted, combinatorial auctions have a "free-rider" problem. This problem is *not* solved by CTIA's proposal to announce the combinatorial bids prior to the individual auctions, because these bids are still likely to discourage participation in the individual auctions.<sup>8</sup> The free-rider problem persists even when all combinations are

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<sup>7</sup> CTIA itself discusses only limited combinatorial auctions, effectively contradicting their expert, Professor Isaac, who argues for the benefits of full (i.e., all subsets) combinatorial auctions. As he states: "With the FCC plan, it is still all or nothing, and some of the disadvantages of non-combinatorial bidding remain." However, Professor Isaac also acknowledges the potential inefficiency of full combinatorial auctions. He then, somewhat illogically, considers that this means a separate auction for a national license is desirable.

<sup>8</sup> CTIA's expert, Professor Isaac, would have the results of the national auction announced *before* the individual MTA bidding. In contrast, Bell Atlantic's experts would have the results of the national auction announced *after* the individual MTA bidding is complete. Neither of the proposals succeed in eliminating the free-rider problem. In particular,

allowed. Professor Isaac's proposal, which requires announcing the outcome of the national license prior to the oral auctions for the individual MTAs, does not solve the free-rider problem as alleged, although it reduces the free-rider problem under some circumstances. In particular, CTIA's proposal does not solve the problem that a bidder on a national license has a disincentive to participate in the individual MTA auctions. In the example provided in my prior report (see PacTel Auction Design Comments at 13-14), the use of CTIA's proposed auction continues to create inefficient aggregation.

The second problem with combination bids is the huge number of potential combinations.<sup>9</sup> Because bidders can create their own combinations and bid on them, there may be thousands or even hundreds of thousands of auctions open simultaneously. This plethora of auctions will strain the capacity of competitors even to keep track of who is currently winning the auctions. The Commission should reject full combinatorial auctions because of the necessity of complex software and the immensely complex problem of bidding in these auctions, as well as the free-rider inefficiency they create. Full combinatorial auctions cannot be described as "transparent," i.e., easily understood by bidders. In particular, the admission of any combination a bidder desires permits the

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bidders for a national license have a disincentive to participate in the individual MTA auctions, for participating in those auctions makes their national license less likely to succeed. If a bidder for a national license is the highest value holder of some, but not all MTAs, that bidder's incentive to stay out of the competition for individual MTAs creates an inefficiency that persists no matter when the results of the national competition are announced.

<sup>9</sup> To make this point forcefully, consider the 492 BTAs. In a full combinatorial auction for just one of the channel blocks C-G, bidders could choose to bid on any possible subset of the BTAs. There are, in scientific notation,  $1.28 \times 10^{148}$  such subsets. The exact number is 12, 786, 062, 094, 304, 179, 739, 022, 253, 232, 809, 188, 346, 257, 992, 355, 721, 833, 919, 106, 906, 625, 522, 642, 205, 759, 980, 012, 773, 798, 148, 063, 113, 870, 651, 109, 873, 281, 527, 379, 754, 908, 382, 364, 816, 614, 564, 560, 895. This number is much larger than the number of electrons in the universe, estimated to be  $10^{87}$ .



bidders to "game" the system, creating complicated aggregations for the sole purpose of blocking other bidders.<sup>10</sup>

In contrast to the claims of NTIA, full combinatorial auctions are not necessary when simultaneous auctions are used. Bidders can express a preference for a particular aggregation by bidding aggressively on the individual licenses of the aggregation. Thus, full combinatorial bidding creates needless complexity.

Finally, electronic auctions are one method of achieving simultaneous bidding, but not the only method. In my opinion, the Commission should use multiple rounds of sealed bids in lieu of electronic auctions because of the limited time to set up, test, and debug an electronic auction. Multiple rounds of sealed bids are easily understood by the bidders and avoid the use of complex computer software. In my view, there is insufficient time to deploy electronic auctions, while multiple rounds of sealed bids can be deployed in a matter of days.

## **VI. Summary and Conclusions**

A consistent theme in the comments is that ascending bid auctions are preferable to one-time, sealed-bid auctions. This is correct. However, the best method to carry out ascending bid auctions for PCS license rights is with several rounds of sealed bids rather than oral bids. Simultaneous ascending bid auctions encourage efficient allocations of the spectrum, avoiding the biases inherent in sequential, oral auctions. Simultaneity permits the auctions to be completed more rapidly, yet still allow adequate time for

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<sup>10</sup> In fact, a clever bidding strategy in combinatorial auctions involves creating complicated geographical aggregations and bidding on those, in order to defeat bids on others' aggregations. That is, optimal bidding strategies may involve lots of strange aggregations, with the sole purpose of blocking others' aggregations. It may also be desirable to "muddy the water" to make one's opponents' lives difficult, by bidding on hundreds of thousands of aggregations.

deliberation and careful, informed bidding. The use of several rounds of sealed bids to carry out the simultaneous auctions avoids the necessity to develop, test, and debug new computer software and makes the auction easily understood by bidders.

The use of sequential oral auctions may cause license rights sold early to sell for too little. Until bidders observe the strategies of other bidders, they will choose to be conservative to avoid over-bidding, thus falling victim to the "winner's curse." This conservative bidding will become apparent as the sequential auctions proceed. In contrast, simultaneous auctions allow bidders to apply information from all of the auctions to each auction in which they bid, mitigating the "winner's curse," promoting more informed decisions, and resulting in a more efficient allocation of the PCS spectrum.

Oral auctions, by revealing the identities of the bidders, increase the likelihood of implicit collusion. In addition, revealing the participation of bidders with better information or deeper pockets may dampen competition, thus reducing the prices paid. In contrast, simultaneous rounds of sealed bids permit the Commission to conceal the identities of the bidders.


A separate auction for a national license promotes inefficient aggregation of the licenses, as was argued by many respondents. Offering a national license is both unnecessary and inefficient if the Commission auctions the licenses simultaneously. If a national license makes good business sense, it will be established with the simultaneous auction design described here.

Full combinatorial auctions suffer from three flaws. First, they encourage inefficient aggregations because of the "free-rider" problem identified by the Commission. Second, they are not readily understood by bidders, since bidders can employ extremely complex bidding strategies. Finally, they are computationally prohibitive, as bidders may choose to bid on hundreds of thousands of licenses.

In sum, the auction design that best achieves the Commission's goals consists of the use several rounds of sealed bids in which all geographic areas for given spectrum blocks are auctioned simultaneously.

**CERTIFICATE OF SERVICE**

I, Pamela J. Riley, do certify that on or before November 30, 1993 copies of the foregoing Reply Comments of PacTel Corporaton were either (1) sent via Federal Express (names marked with an asterick), (2) hand delivered, or (3) deposited in the U.S. Mail, first class, postage prepaid to the persons on the attached service list.

  
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